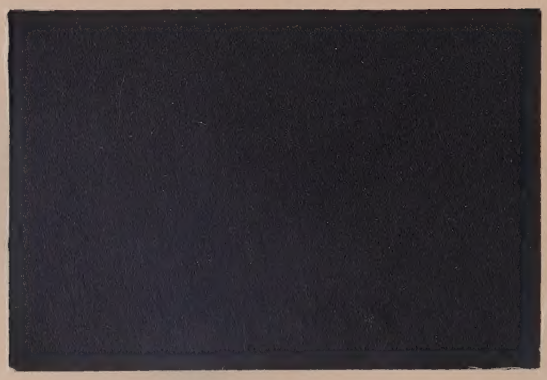
BALLANTINE LABORATORIES - BOONTON - N. J.

MODEL 700

PRECISION SENSITIVE INVERT

BALLANTINE ELECTRONIC INSTRUMENTS



MODEL 700

PRECISION SENSITIVE INVERTER

INSTRUCTION BOOK

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BALLANTINE SENSITIVE INVERTER
MODEL 700

1. SPECIFICATIONS

Input Voltage Range..... 10 uv - 100

Threshold of Detection..... 1 uv

Power Sensitivity..... 10-19 watt

Ratio of DC Input to AC RMS Output..... 1:100 & 10:1

Inversion Stability (above 100 uv input)..... 1%
Includes (a) possible variations of inversion ratio occurring during an extended continuous period of use,
(b) the effects of non-linearity up to the maximum output level of 10 volts RMS and
(c) random variations arising from fluctuations in noise level and zero offset potentials.

Calibrator Accuracy..... 0.25%

Response Time (90% of final amplitude)..... 0.25 sec

Input Conditions
DC Input Resistance for 1:100 ratio..... 10 megohms
for 10:1 ratio..... 50 megohms
AC Input Impedance..... 0.2 megohms

Equivalent Input Noise Level) for 1:100..... Approx 3 uv
Including Zero Offset) for 10:1..... Approx 3 mv

Output Conditions
AC Output Frequency..... Line Frequency (approx 60 cps)

Max AC Output Level..... 10v RMS

Total Distortion in Output Wave Form..... 2%

Minimum Load Impedance Permissible..... 50,000 ohms

Output Impedance..... Equivalent to 0.13 uf in series with 10,000 ohms resistance

Power Requirements..... 105-125 v; 50-70 cps; 15 watts

Stability
Effect of line voltage change between 105 and 125 v..... 0.5%
Effect of line frequency change between 55 and 65 cps..... 2%
(Calibrator may be used to eliminate these errors if the change is a long-term effect)

Ambient Temperature Range..... 0° to +35°

Tubes..... One 12AY7; one 12AT7; one 6X4; one 0A2; one 5651

Dimensions..... 6" high; 6-3/4" wide; 10-7/8" long

Weight..... 11 pounds

SENSITIVE INVERTER

MODEL 700

2. GENERAL SCOPE OF INSTRUMENT

The Ballantine Sensitive Inverter Model 700 fulfills the need for a stable, precise device which will permit the detection and measurement of dc potentials approaching microvolt levels without imposing heavy resistance loading on the source. The instrument inverts the dc potential under consideration to a 60 cps ac wave which is then amplified by a known factor to a level observable by one of a wide variety of ac voltmeters. This 60 cps wave appearing at the output of the Inverter has its amplitude and phase determined by the voltage and polarity, respectively, of the dc signal at the input.

When used ahead of a suitable ac voltmeter, the Model 700 makes possible

(a) the accurate measurement of dc potentials from 100 volts down to as low as 10 microvolts, and

(b) the detection of dc potentials as low as 1 microvolt.

The input resistance of the Inverter is either 50 megohms or approximately 10 megohms, depending on the range employed.

Very low frequency potentials from dc to 0.5 cps may also be observed and measured with the inverter since such an input signal will result in an amplitude-modulated wave having a carrier frequency of 60 cps and a peak amplitude proportional to that of the input signal.

The Model 700 Inverter may be combined with a vacuum tube voltmeter, multimeter, voltage amplifier, servo-amplifier, audio null detector-amplifier, oscilloscope, or any other device (responding 60 cps voltages in the range 100 microvolts to 10 volts RMS and having an input impedance greater than 50,000 ohms) in order to render that device sensitive to dc potentials ranging from 1 microvolt to 100 volts. Ballantine Sensitive Electronic Voltmeters are particularly suited for use with the Model 700 Inverter because of the logarithmic voltage scale featured on all Ballantine voltmeters to preserve constant accuracy at all scale points. The logarithmic voltage scale is advantageous when the voltmeter is used as a bridge detector since it provides a gradual increase in sensitivity as the null point is approached. Although the Model 300 Electronic Voltmeter may be regarded as a standard instrument for use with the Inverter, inquiries are invited as to the preferred suitability of other types of Ballantine Voltmeters for performing dc or sub-audio voltage measurements in combination with the Inverter.

Measurements above 100 volts to a limit of 15 kilovolts dc may be made when a plug-in multiplier, Ballantine Model 1700, is used in conjunction with the Inverter.

An important feature of the Model 700 Inverter is a built-in calibrator which permits correction of the major errors caused by a companion instrument or by the departure of line frequency and voltage from nominal values. Other feature are:

(1) high power sensitivity,
(2) high input resistance,
(3) distortion-free 60 cps sine wave output,
(4) immunity to 60 cps pick-up voltages,
(5) means for polarity sensing,
(6) extremely small zero drift.

3. OPERATION

The Model 700 is supplied with tubes and is ready to operate as received. Connect the power cord to a source of 105-125 volts, 50-70 cps, and turn on the ON-OFF switch. The red pilot light should glow when the power is on. Allow a five minute warm-up period before use. The inverter should be operated at all times with its feet in a horizontal plane.

3.1 CONNECTION TO A COMPANION INSTRUMENT.

A shielded output connector lead is provided for connection of the inverter to the input terminals of the companion instrument. If the connector lead is not satisfactory because of its length of terminal fittings, any other shielded connector of any practical length and having not more than .01 uf leading capacitance may be used. The inverter output terminals are provided by a Type N coaxial receptacle.

3.2 DC VOLTAGE MEASUREMENTS

3.2.1 Desired Characteristics of Associated AC Voltmeter

In order to measure dc potentials accurately in the full specified range of the inverter the AC voltmeter connected to the output terminals should satisfy the following requirement:

(a) Be capable of indicating over a range of 1 millivolt to 10 volts. An instrument having a lower sensitivity than 1 millivolt can be employed but then the minimum measurable dc voltage will be restricted accordingly.

(b) Its indications should be of RMS voltage if a simple decimal correlation is to exist between the voltmeter reading and the observed dc voltage. Peak or average responding voltmeters are entirely acceptable in this respect if calibrated in terms of RMS voltage of sine wave.

(c) Its input impedance may not be less than 50,000 ohms at 60 cps.

3.2.2 Method of Measurement

Before proceeding with the following instructions it is recommended that for a full appraisal of the scope of the Inverter, Section 3.3 on the use of the built-in calibrator, and Section 3.4 on polarity checking, should be read.

(a) Connect the output of the Inverter to the input of an AC voltmeter meeting the above requirements. Use the special shielded connecting lead supplied, if possible.

(b) Before making connection to the voltage source, check and calibrate if necessary. See instructions on the use of the built in calibrator, Section 3.3. The following check of the inverter renders frequent repetition of this check unnecessary if a high quality comparator voltmeter is used.

(c) Do not permit any external connection to exceed [illegible] Inverter input terminals marked L and earth. Nor permit [illegible] or inverter output terminals.

(d) To measure voltages:

below 100 millivolts, press 1:100 VOLTAGE RATIO button
above 100 millivolts, press 10:1 VOLTAGE RATIO button

The magnitude of the DC input voltage is equal to the

RMS voltage reading x 100 for 1:100 VOLTAGE RATIO, and
RMS voltage reading x 10 for 10:1 VOLTAGE RATIO.

A slight unsteadiness in voltage indication dependent on the meter damping of the AC voltmeter will occur for input voltages in the region of 10 microvolts on the 1:100 ratio or for 10 millivolts on the 10:1 ratio.

(f) For maximum accuracy, voltages below 100 microvolts should be measured as outlined in the following section.

[illegible]nstructions for Accurate Measurements Below 100

[illegible]t circuit the inverter input terminals and press the [illegible] POLARITY button. Observe the voltage reading, which [illegible] 10 or more microvolts as read according to [illegible]ection 3.2.2 (e).

(b) Below 10 Microvolts

Note the average of voltage reading, which will be rather unsteady at these low levels and then press the left-hand POLARITY button and note the new voltage reading. A change of approximately 10 microvolts indicates the input terminal is positive with respect to L, whereas change distinctly less than 10 microvolts indicates opposite polarity conditions.

VOLTAGE MEASUREMENTS ABOVE 100 VOLTS

urements of dc potentials from 100 to 15,000 volts may be made

atories, Inc.) is attached to the input terminals of the

loading resistance presented to the source of the multiplier

(a) Plug the multiplier into the inverter binding posts while observing that the plug marked GND mates with the binding post

(b) Depress the 10:1 VOLTAGE RATIO button and connect the source of high voltage to be measured to the terminals of the multiplier. The magnitude of the dc voltage applied to the multiplier is equal to the RMS voltage reading of the companion ac voltmeter X10,000.

5.1 Accuracy of Inverter-Multiplier Combination

The overall error for the range of 100 to 15,000 volts will not exceed 5% provided the built-in calibrator is used as described in Section 3.4.

CIRCUIT DESCRIPTION

The circuit consists of a DC chopper, synchronized at line frequency, followed by a low pass filter, and followed by a selective amplifier tuned to the band pass 50 to 70 cps.

The input filter serves to reduce errors caused by AC voltages appearing at the input. These AC voltages may exist in the DC voltage source or may be induced in the input leads by stray external fields. Attenuation of 60 cps input voltages is at least 45 DB, more than sufficient to eliminate errors caused by 60 cps pickup in most laboratories, and shops.

repair department will give it their prompt attention and will proffer advice

(b) The 5651 or the 12A7 should not be replaced unless a precision instrument capable of measuring 100V or 10V with better than 0.1% accuracy is available for recalibrating the source of standard voltage.

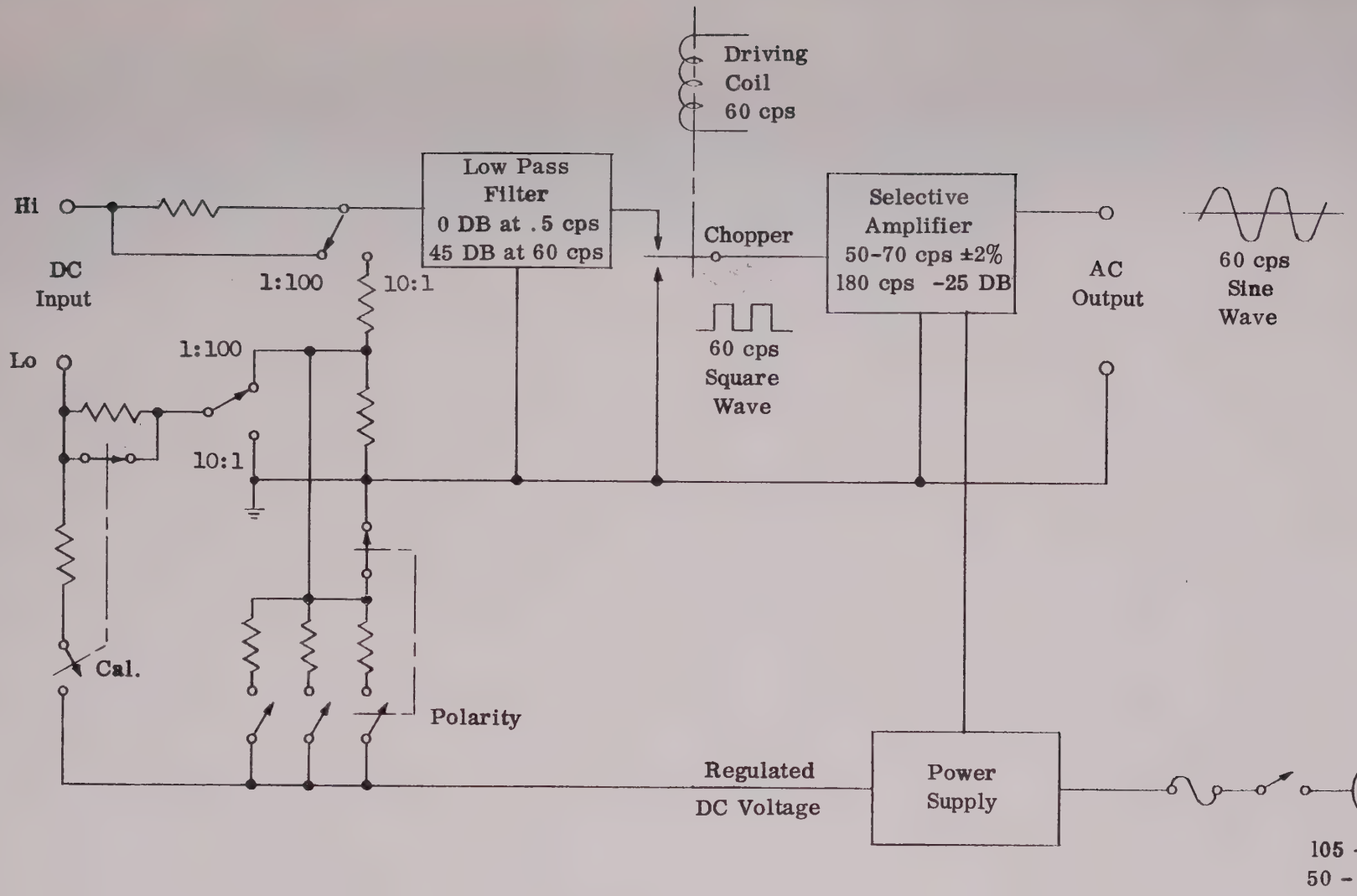
(c) To reestablish the standard reference voltage after either one or both of these tubes have been replaced, unscrew the four nickel plated screws on the front panel and remove the instrument from the box. The reference voltage appears between the chassis and the L input terminal when the 0.1 1V DCV button is operated. Using the potentiometer to ensure this voltage is terminal precisely obtain 100V ± 0.1% on 1:100 range by adjusting the small wirewound rheostat closer to the power on terminal board on back side of the chassis or 10V ± 0.1% on 10:1 range by adjusting the rheostat close to the 100K ohm wirewound resistor on board.

6. WARRANTY

We warrant each instrument sold by us to be free from defects in material and workmanship. Our obligation under this warranty is limited to repairing or replacing any instrument or part thereof, except tubes or batteries which shall within 1 year after shipment to the original purchaser prove upon our examination to be defective.

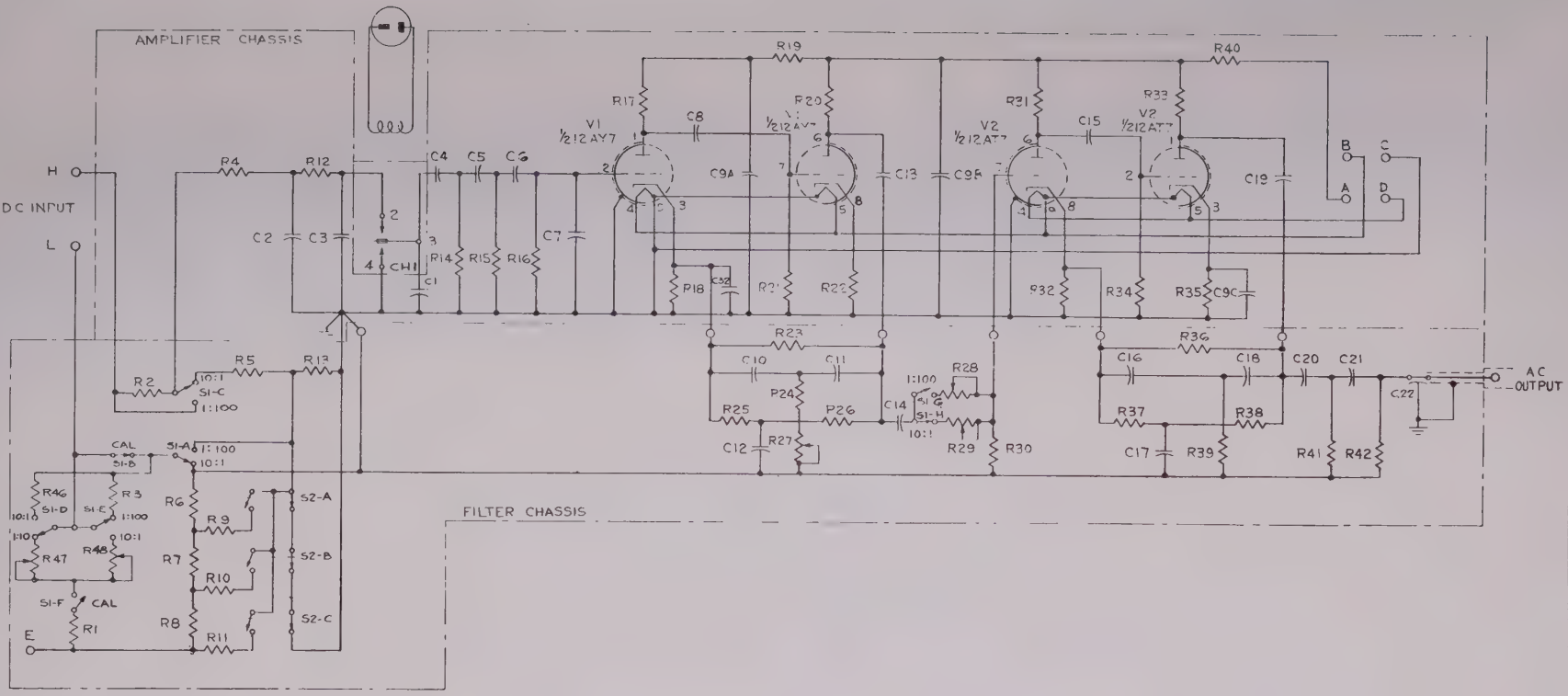
7. SHIPPING INSTRUCTIONS

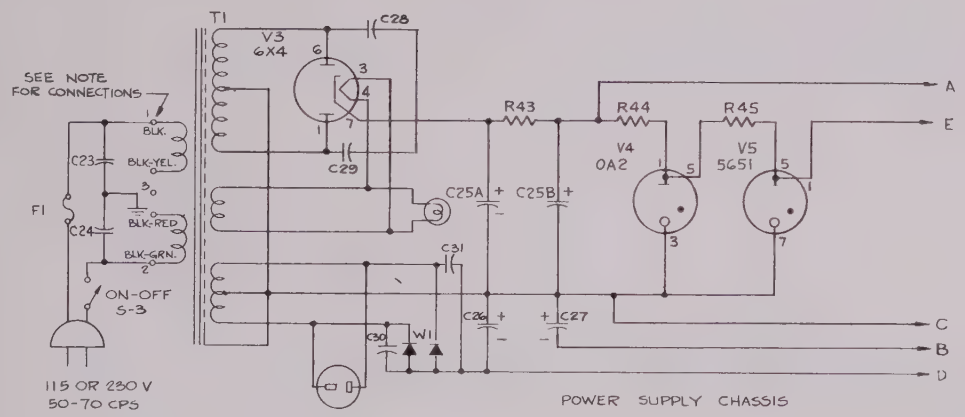
If it should become necessary to return the instrument to us for servicing, make certain that at least 3 or 4 inches of padding material surround the instrument. Ship via Railway Express collect.



BLOCK DIAGRAM

MODEL 700 SENSITIVE INVERTER





MODEL 700
ISSUE E

FOR 115V INPUT CONNECT BLACK AND BLACK-RED TO TERM. "1 AND CONNECT BLACK-YELLOW AND BLACK-GREEN TO TERM "2. F1-½ AMP.

FOR 230V INPUT CONNECT BLACK TO TERM."1, BLACK-GREEN TO TERM "2, AND BLACK-YELLOW AND BLACK RED TO TERM "3. F1-¼ AMP.

BALLANTINE LABORATORIES, INC.
BOONTON, N. J.

REPLACEMENT PARTS LIST

REFER TO MODEL 700 SCHEMATIC DIAGRAM, ISSUE E

B.C. No.	CIRCUIT SYMBOL	RESISTORS	MANUFACTURER
[illegible]	R1	164,000 ohms, Type 12, Alloy E, 1%,	Shallcross
[illegible]	R2	50,000,000 ohms, Type CP-2, 1%,	Wilkor
1610	R3	19.8 ohms, Type BX12E, Alloy E, 1%,	Shallcross
1305	R4	200,000 ohms, Type CP-½, 5%,	Wilkor
1311	R5	50,000 ohms, Type CP-½, 1%,	Wilkor
1051	R6	2,000 ohms, Type EB, 5%,	Allen-Bradley
1034	R7	39,000 ohms, Type EB, 5%,	Allen-Bradley
1008	R8	1.0 megohm, Type EB, 5%,	Allen-Bradley
1010	R9	1.0 megohm, Type EB, 5%,	Allen-Bradley
1010	R10	1.0 megohm, Type EB, 5%,	Allen-Bradley
1010	R11	1.0 megohm, Type EB, 5%,	Allen-Bradley
1305	R12	200,000 ohms, Type CP-½, 5%,	Wilkor
1358	R13	60 ohms, Type CP-½, 1%,	Wilkor
1000	R14	22,000,000 ohms, Type EB, 10%,	Allen-Bradley
1000	R15	22,000,000 ohms, Type EB, 10%,	Allen-Bradley
1001	R16	10,000,000 ohms, Type EB, 10%,	Allen-Bradley
1551	R17	1,000,000 ohms, Type 1W, 1%,	Elec. of Col
1552	R18	15,000 ohms, Type NF½, 1%,	Nobeley
1025	R19	120,000 ohms, Type EB, 10%,	Allen-Bradley
1036	R20	33,000 ohms, Type EB, 5%,	Allen-Bradley
1007	R21	2,000,000 ohms, Type EB, 10%,	Allen-Bradley
1057	R22	1,000 ohms, Type EB, 5%,	Allen-Bradley
1361	R23	240,000 ohms, Type CP-½, 1%,	Wilkor
1322	R24	12,000 ohms, Type CP-½, 1%,	Wilkor
1310	R25	56,000 ohms, Type CP-½, 1%,	Wilkor
[illegible]	[illegible]	[illegible]	[illegible]
1904	R27	20,000 ohms, Type Q Volume Control, 20%,	I.R.C.
[illegible]	[illegible]	[illegible]	[illegible]
1909	R29	75,000 ohms, Type Q Volume Control, 20%,	I.R.C.
1305	R30	200,000 ohms, Type CP-½, 1%,	Wilkor
1013	R31	750,000 ohms, Type EB, 5%,	Allen-Bradley
[illegible]	R32	7,500 ohms, Type CP-½, 1%,	Wilkor
[illegible]	R33	33,000 ohms, Type EB, 5%,	Allen-Bradley
[illegible]	R34	2,000,000 ohms, Type EB, 10%,	Allen-Bradley
[illegible]	R35	750 ohms, Type EB, 5%,	Allen-Bradley
[illegible]	R36	170,000 ohms, Type CP-½, 1%,	Wilkor
[illegible]	R37	38,000 ohms, Type CP-½, 1%,	Wilkor
[illegible]	R38	38,000 ohms, Type CP-½, 1%,	Wilkor
[illegible]	R39	19,000 ohms, Type CP-½, 1%,	Wilkor
[illegible]	R40	10,000 ohms, Type EB, 5%,	Allen-Bradley
[illegible]	[illegible]	51,000 ohms, Type EB, 5%,	Allen-Bradley
[illegible]	[illegible]	51,000 ohms, Type EB, 5%,	Allen-Bradley
[illegible]	[illegible]	2,400 ohms, Type HB, 5%,	Allen-Bradley
[illegible]	[illegible]	9,100 ohms, Type HB, 10%,	Allen-Bradley
[illegible]	[illegible]	20,000 ohms, Type HB, 10%,	Allen-Bradley
[illegible]	[illegible]	22,000 ohms, Type 12, Alloy E, 1%,	Shallcross
[illegible]	[illegible]	5,000 ohms, Type 39, 20%,	Clarostat
[illegible]	[illegible]	[illegible] Type 39, 20%,	Clarostat

REPLACEMENT PARTS LIST

REFER TO MODEL 700 SCHEMATIC DIAGRAM, ISSUE B

B.L. PART NO.	CIRCUIT SYMBOL	CONDENSERS	MANUFACTURER
2224	C1	100 mfd., Type CM15E-101-J, 500v, 20%,	Arco
2163	C2	0.22 mfd., Type 612G22402, 200v, 20%,	Goodall
2163	C3	0.22 mfd., Type 612G22402, 200v, 20%,	Goodall
2133	C4	0.0056 mfd., Type PM Mylar, 600v, 20%,	Cornell-Dubil
2122	C5	0.005 mfd., Type ZNW2D5, 200v, 20%,	Cornell-Dubil
2122	C6	0.005 mfd., Type ZNW2D5, 200v, 20%,	Cornell-Dubil
2238	C7	.000470 mfd., Type K060, 500v,	Cornell-Dubil
2124	C8	0.005 mfd., Type STO4D5, 400v, 20%,	Cornell-Dubil
2006	C9A	20 mfd., Type UP2230C, 300v,	Cornell-Dubil
2006	C9B	20 mfd., Type UP2230C, 300v,	Cornell-Dubil
2006	C9C	20 mfd., Type UP2230C, 25v,	Cornell-Dubil
2147	C10	0.047 mfd., Type 620M, 200v, 5%,	Goodall
2147	C11	0.047 mfd., Type 620M, 200v, 5%,	Goodall
2148	C12	0.1 mfd., Type 620M, 200v, 5%,	Goodall
2312	C13	6 mfd., Metapup Style H, 150v, 20%,	Cornell-Dubil
2146	C14	.047 mfd., Type 621M, 200v, 20%,	Goodall
2124	C15	0.005 mfd., Type STO4D5, 400v, 20%,	Cornell-Dubil
2148	C16	0.1 mfd., Type 620M, 200 v, 5%,	Goodall
2149	C17	0.22 mfd., Type 621M, 200 v, 5%,	Goodall
2148	C18	0.1 mfd., Type 620M, 200 v, 5%,	Goodall
2312	C19	6 mfd., Metapup Style H, 150v, 20%,	Cornell-Dubil
2302	C20	0.25 mfd., Type MP2P25, 200v, 20%,	Cornell-Dubil
2302	C21	0.25 mfd., Type MP2P25, 200v, 20%,	Cornell-Dubil
2576	C22	.0015 mfd., Type 362-152, 500v, 20%,	Erie
2216	C23	0.006 mfd., Type 1D5D6, 500v, 20%,	Cornell-Dubil
2216	C24	0.006 mfd., Type 1D5D6, 500v, 20%,	Cornell-Dubil
2007	C25A	20-80 mfd., Type FP235, 450-350 volt,	Mallory
2007	C25B	20-80 mfd., Type FP235, 450-350 volt,	Mallory
2019	C26	1,000 mfd., Type UP1M-15, 15v,	Cornell-Dubil
2020	C27	3,000 mfd., Type UP3M-10, 10v,	Cornell-Dubil
2239	C28	.01 mfd., Type CCD-103, 1500v,	Arco
2239	C29	.01 mfd., Type CCD-103, 1500v,	Arco
2239	C30	.01 mfd., Type CCD-103, 1500v,	Arco
2239	C31	.01 mfd., Type CCD-103, 1500v,	Arco
2238	C32	0.000470 mfd., Type K060, 500v,	Cornell-Dubil

3035	T1	- Transformer, Ballantine Special
3403	FUSE	- Littelfuse Type 3AG, 1/2 ampere
3451	PILOT LIGHT	- #47, General Electric Supply
3115	V1	- Type 12AY7 Tube
3116	V2	- Type 12AT7 Tube
3105	V3	- Type 6X4 Tube
3106	V4	- Type OA2 Tube
3117	V5	- Type 5651 Tube

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